REMARKS/ARGUMENTS

In response to the Office Action mailed October 20, 2006, Applicants amend their application and request reconsideration. No claims are cancelled or amended.

The invention concerns a steering control apparatus for a vehicle. The control apparatus may be applied to a wireless electric power steering apparatus in which there is no mechanical connection between the shaft of a steering wheel and the mechanism that changes the angle of steered wheels of the vehicle. In addition, the steering control apparatus according to the invention can be applied to a steering system when there is a mechanical connection between the steered wheels and the steering wheel as, for example, described with respect to the embodiments of Figures 9, 10, and 12 of the patent application.

In the steering control apparatus according to the invention, the steering shaft reaction torque is estimated and a reference road reaction torque is estimated. These estimated torques, relating to the turning force applied to the steering wheel to resist its turning, and relating to the turning force applied by the road and resisting the turning of the steered wheels, are used to establish a target steering reaction torque that, in turn, is used to drive a motor. This motor provides a reaction torque to the steering wheel so that the person operating the vehicle receives a tactile indication of the steering. Otherwise, based upon experience in steering strictly mechanically, the person operating the vehicle becomes quite uncertain with respect to steering.

Claim 1, the sole pending independent claim, describes the determination, i.e., generation, of the target steering reaction torque, which is a target value of a steering reaction torque to be applied to the steering wheel to provide the tactile feedback to the driver. That target value steering reaction torque is generated using the steering shaft reaction torque that has been estimated and the reference road reaction torque that has been estimated. This feature distinguishes the claimed invention from the prior art so that claim 1 and dependent claims 2-5 are patentable.

Claim 3 was again indicated to be allowable.

Claim 1 was rejected as anticipated by Kanda (U.S. Patent 6,389,342). This rejection is respectfully traversed.

Kanda is clearly pertinent prior art and relates to an electric power steering system using a steer-by-wire arrangement in which there is no direct mechanical connection between the apparatus turning the wheels of the vehicle and a steering wheel operated by a driver of a vehicle. Like the invention, Kanda measures, as one parameter, torque applied to the steering wheel. In fact, most of the specification of Kanda focuses on steering torque and its determination as well as determination of the position of the steering wheel using a rotary encoder. A torque may also be measured in Kanda based upon an electrical current flowing to the motor 3 that can provide assistance to the driver operating the steering wheel. However, there is no description of any determination of, or estimation of, any variable that might correspond to the road reaction torque, i.e., the torque that is applied to the tires of the vehicle and resists their turning, as in the invention. Kanda in column 10, lines 54-60 only describes measuring the angle of those tires, not a torque.

To reiterate, the steering torque described by Kanda is the torque on the steering wheel side of a steer-by-wire steering system. The reaction force acting on a driver is determined on the basis of this steering torque as described by Kanda in column 6, lines 25-29. In other words, in Kanda the reaction force transmitted to the driver is determined without consideration of the torque acting on the vehicle wheels when the steering wheel is being operated. As a result, the driver cannot obtain knowledge of the condition of the road on which he is driving based upon the "feel" of the steering wheel.

The operation of the Kanda apparatus is described in detail in the passage from column 11, line 31 through column 12, line 29. There is a description of the calculation of an error angle between the angle of the steering wheel and the angle of the tires as determined from the signal provided by the sensor 16. However, there is never any use of any term that might be considered even equivalent to road reaction torque, either as directly measured or, as in the invention, estimated.

Anticipation requires that a prior art publication describe every feature of a claimed invention. Kanda lacks any discussion that might be considered related to road

reaction torque or its estimation that could provide the function of the reference road reaction torque estimation means of claim 1. As already described, in the invention, the steering reaction torque and the reference road reaction torque are employed to inform a driver of the condition of the road on which the vehicle including the claimed apparatus is traveling. If the road becomes slippery so that the coefficient of friction is relatively small, both the steering reaction torque and the reference road reaction torque are reduced, transmitting the road information to the driver. Kanda nether describes nor suggests anything similar. Therefore, Kanda clearly cannot anticipate claim 1. Accordingly, upon reconsideration, the rejection should be withdrawn.

Claims 1, 2, 4, and 5 were rejected as anticipated by Husain et al. (U.S. Patent 6,580,989, hereinafter Husain).

Husain is directed to an electric power steering system that provides steering-by-wire, without any direct mechanical connection to the steering mechanism from the steering wheel, as well as alternative steering systems, including an electronic power assist steering operation and a manual steering operation. The entire thrust of Husain is the lack of acceptance of a steer-by-wire system by drivers used to a conventional power steering system. Thus, through the use of a clutch 50, Husain provides for an election between a steer-by-wire system and a conventional power steering system or the manual steering system. The election is made not by the choice of the driver, but through various tests that are applied to determine whether the components essential to the operation of the steer-by-wire power steering system are functional. If any of those components malfunctions according to the test made, then the steer-by-wire system is not implemented. Instead, one of the alternative systems, conventional power assist or manual power steering, is employed.

The apparatus described by Husain is far more complex than the apparatus described by Kanda. However, there is no description in Hussain of ever estimating or sensing the steering reaction torque. This difference is, alone, sufficient to overcome the rejection.

The Examiner has apparently inferred that the road wheel position sensors 32a and 32b measure reference road reaction torque. It is presumed the Examiner means those

sensors 32a and 32b although the Office Action at page 3, line 2 refers to a torque sensor 33b. A word search of Husain fails to disclose any reference number 33 and, in fact, it appears that the draftsman of that patent used only even numbers, no odd numbers, as reference numbers. According to the only passage concerning these sensors 32a and 32b, at column 3, lines 58-62 of Husain, the road wheel position sensors measure or estimate the angular position of the road wheels and communicate that position information to the controller 16. The position of the wheels has nothing to do with the torque applied to the wheels and therefore it is improper to assert that these sensors determine the road reaction torque. Road reaction torque relates to road surface conditions which the position sensors cannot detect. Since Husain never senses nor estimates road reaction torque or the equivalent, it cannot anticipate any of claims 1, 2, 4, and 5.

Upon reconsideration, the rejection of claims 1, 2, 4, and 5 as anticipated by Husain should be withdrawn.

Prompt allowance of all pending claims is earnestly solicited.

Respectfully submitted,

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